

Excitation of Transient Rossby Wavetrains and their Influence on US Weather

Grant Branstator & Haiyan Teng
NCAR



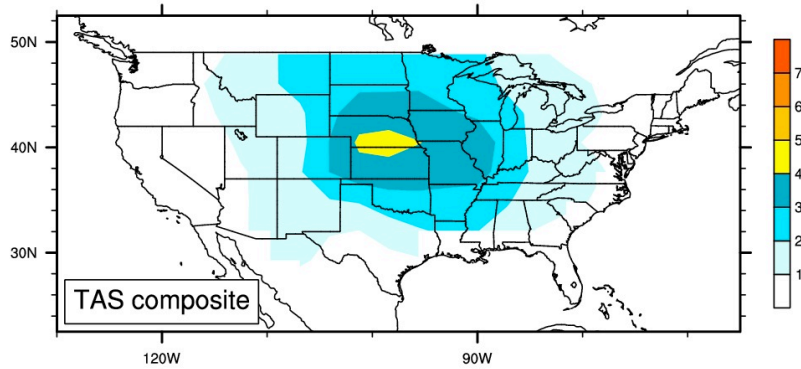
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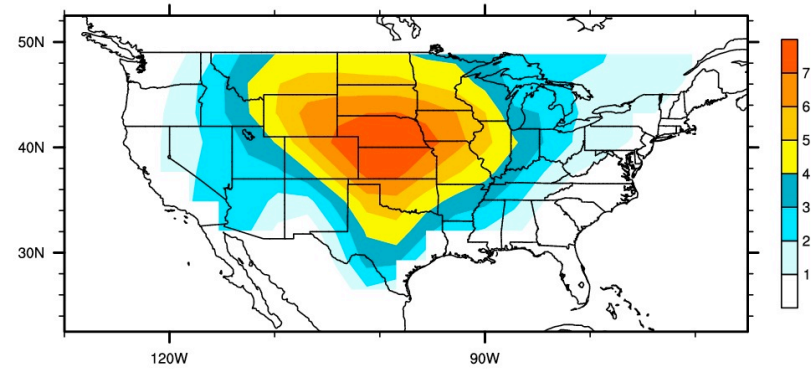
- *Example of Influence on US Extremes*
- *Excitation by Tropical Transient Phenomena*

Heat Waves in Nature and CAM3

Reanalysis 65 yrs



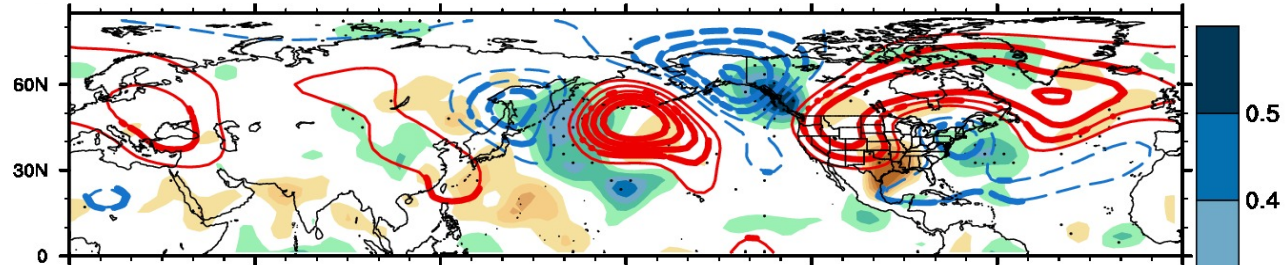
CAM3 12000 yrs



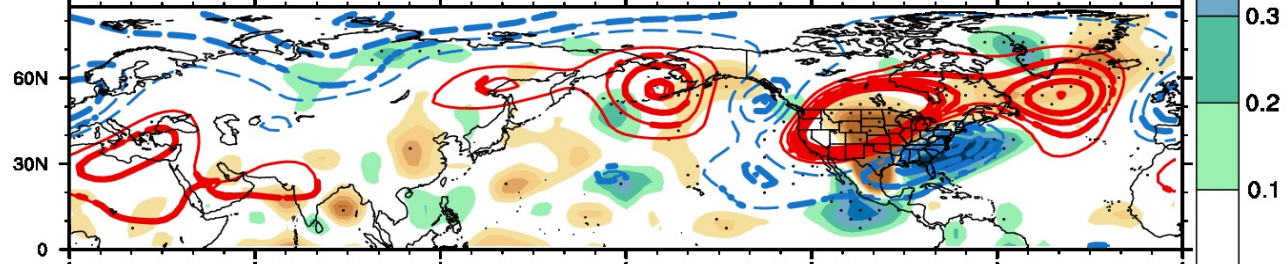
climatological SSTs

Composite of 10-90day filtered psi300/precip

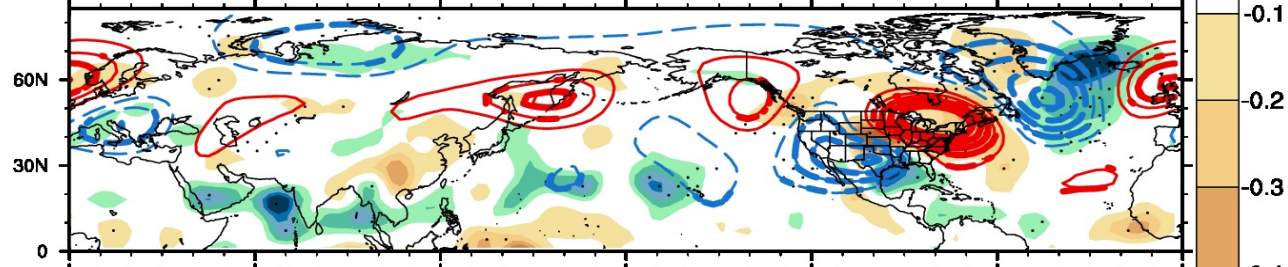
Day -5



Day 0

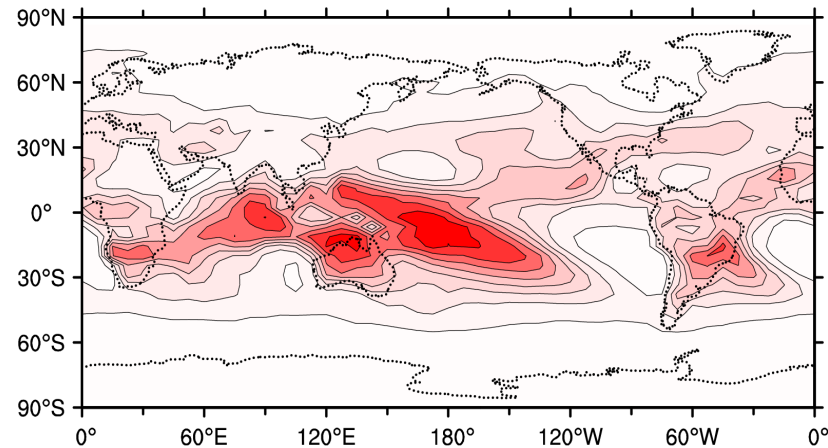


Day 5

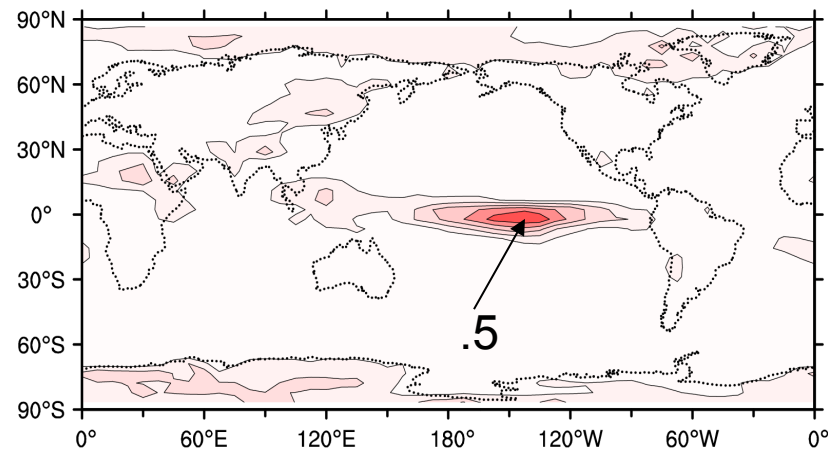


OLR daily variance during DJF

total



interannual/total



July - September 1987 OLR

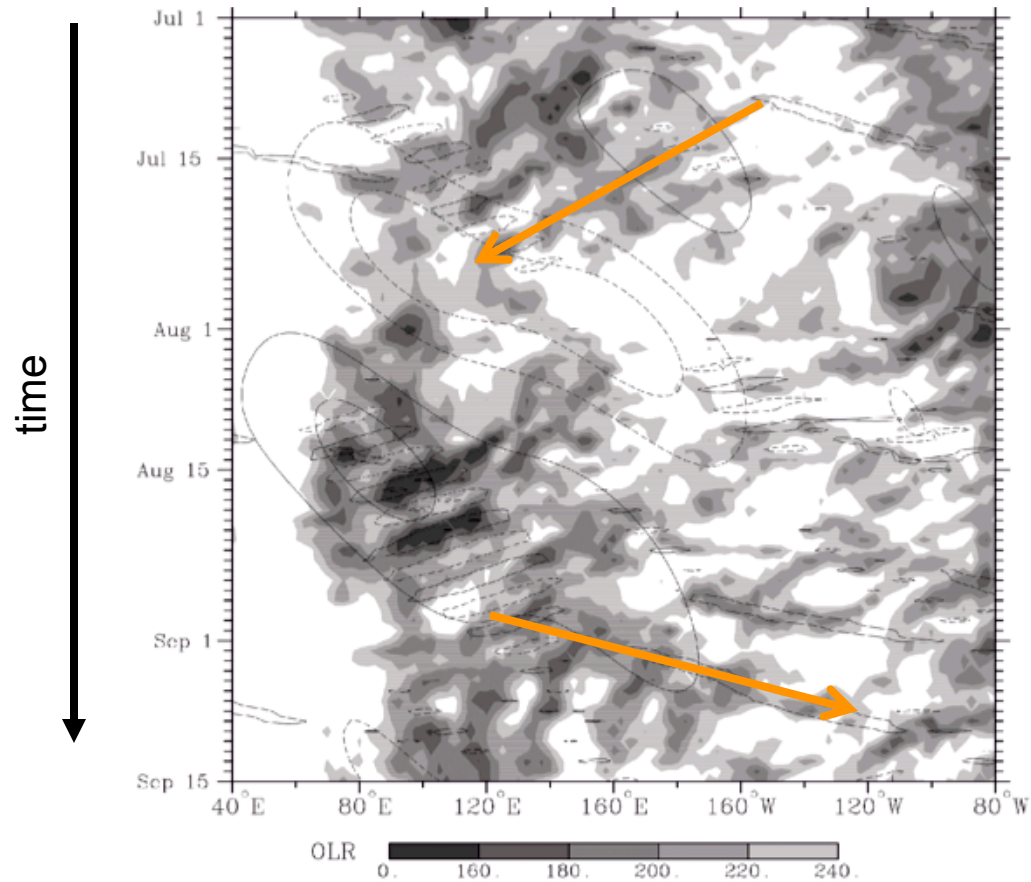


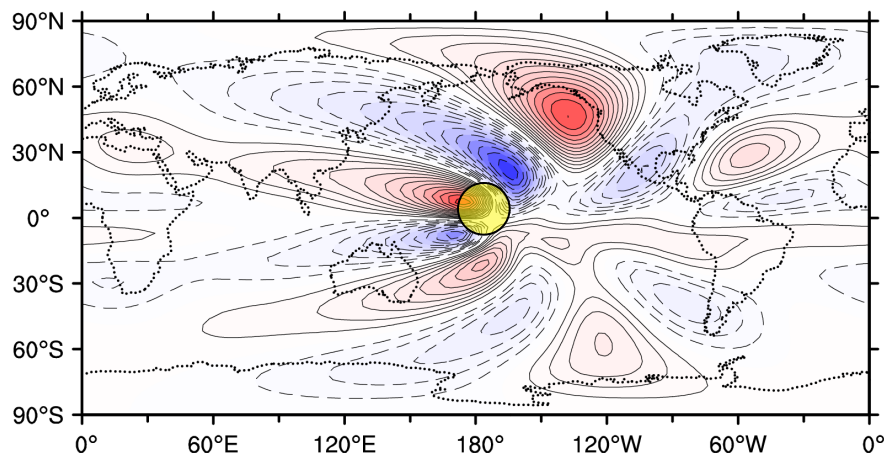
FIG. 6. Time-longitude plot of total OLR (shading, as indicated), filtered ISO, and MRG-TD OLR (contours, solid negative, contour interval 10 W m^{-2} , zero contour omitted), and filtered Kelvin wave OLR (contoured at -12 W m^{-2} only), averaged from 2.5° to 15°N , from 1 Jul to 15 Sep 1987.

Straub & Kiladis (2003)

Linear response to vorticity source

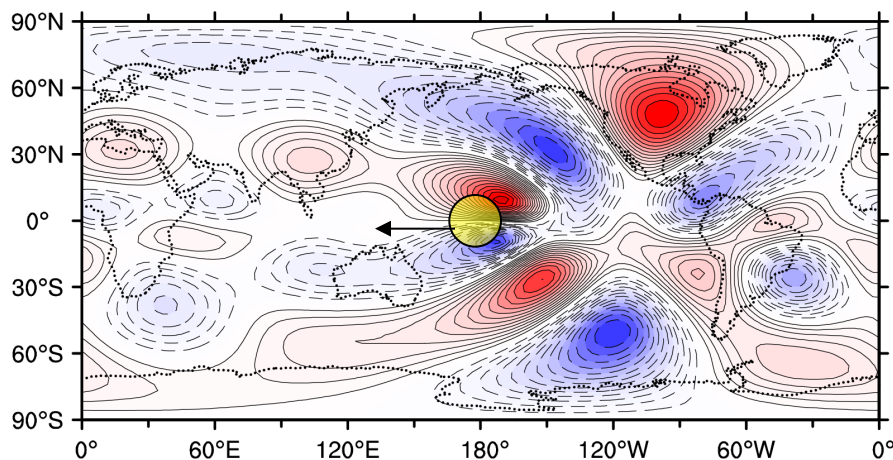
Zonal mean January basic state

Steady

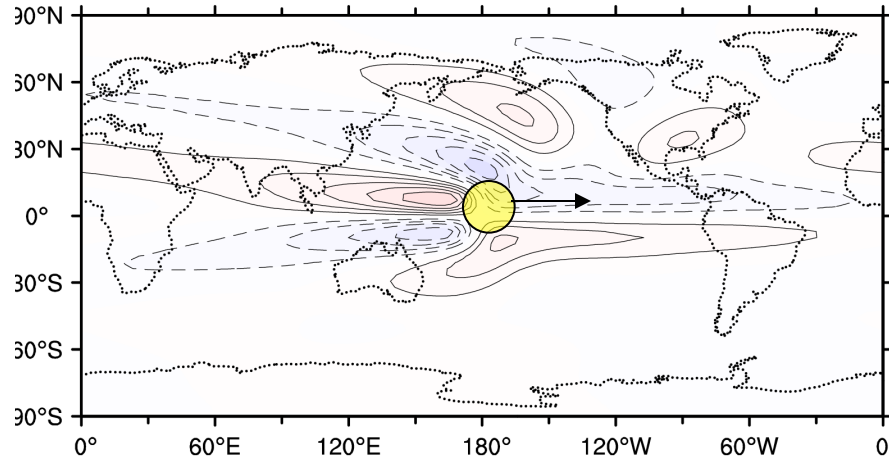


- ◆ group velocity
 - ◆ scale
 - ◆ ray path
 - amplitude, reach
- Yang&Hoskins,1996

-8 deg/d

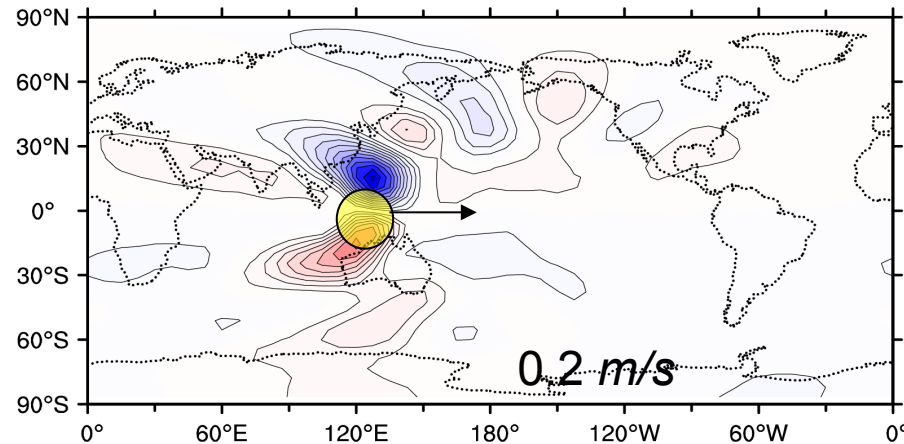


8 deg/d

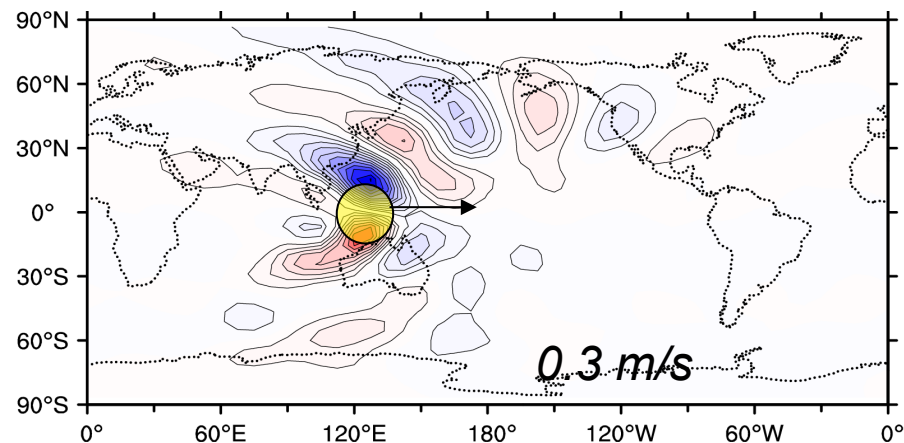


(streamfunction)

V300 response to 5C/day heat source moving at 4deg/d



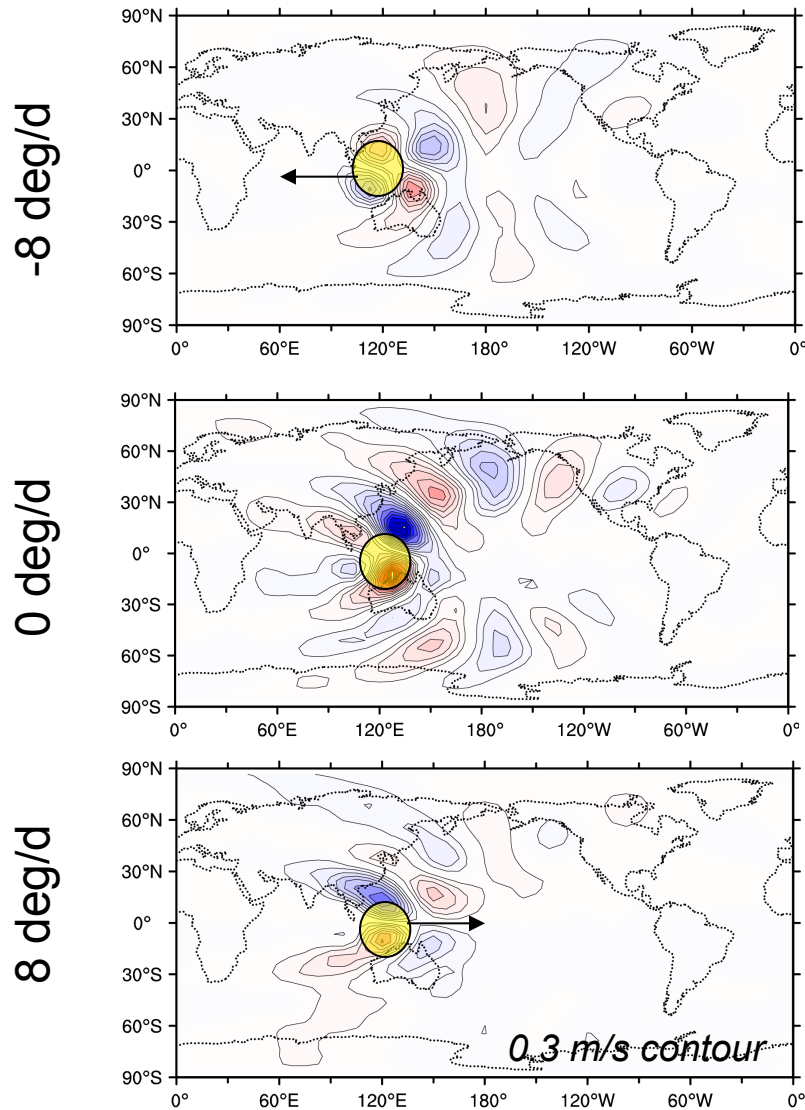
CCM0 ensemble
(15000 members)



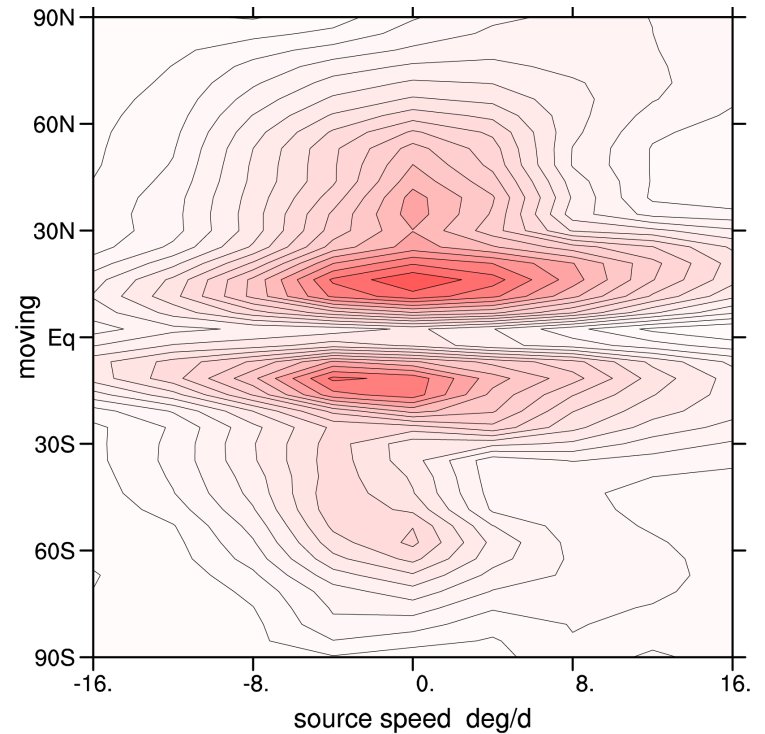
Fluctuation
Dissipation
Theorem
(use statistics of
natural variability)

Dependence of V300 response amplitude on source speed

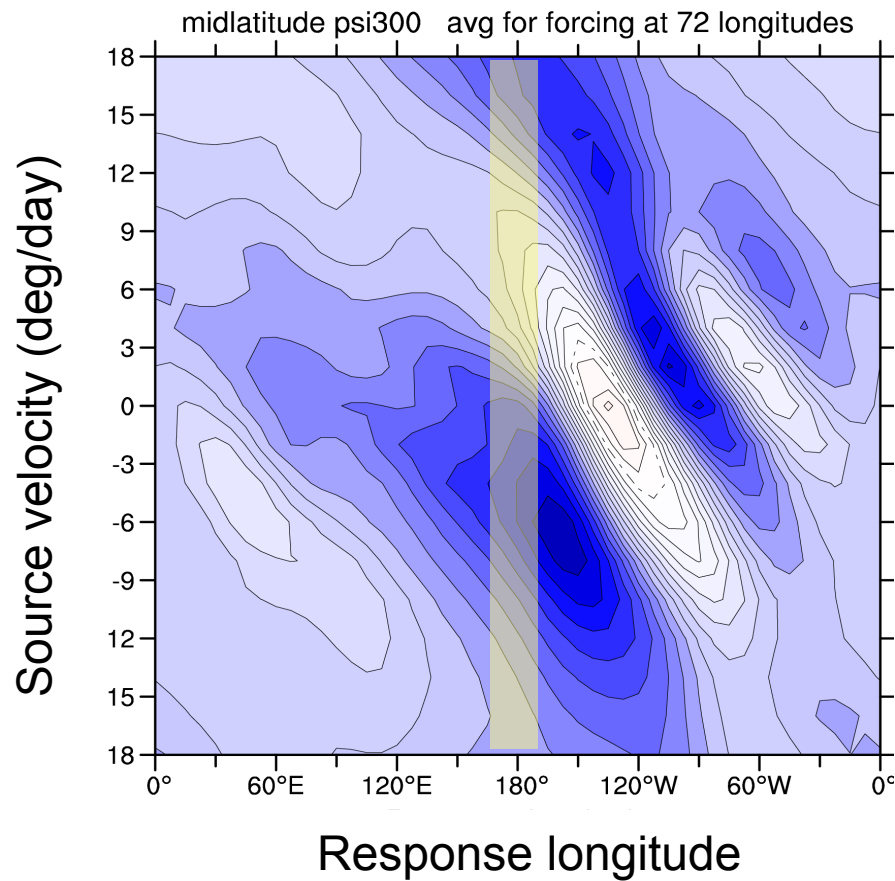
CCM0/FDT



Standard deviation of v300
using mean v300



Response to moving eq heat source midlatitude ψ_{300}

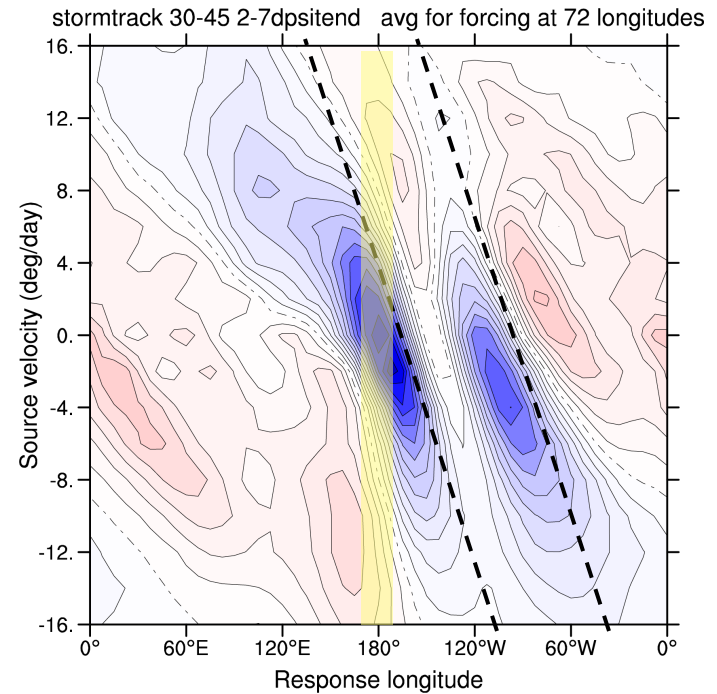
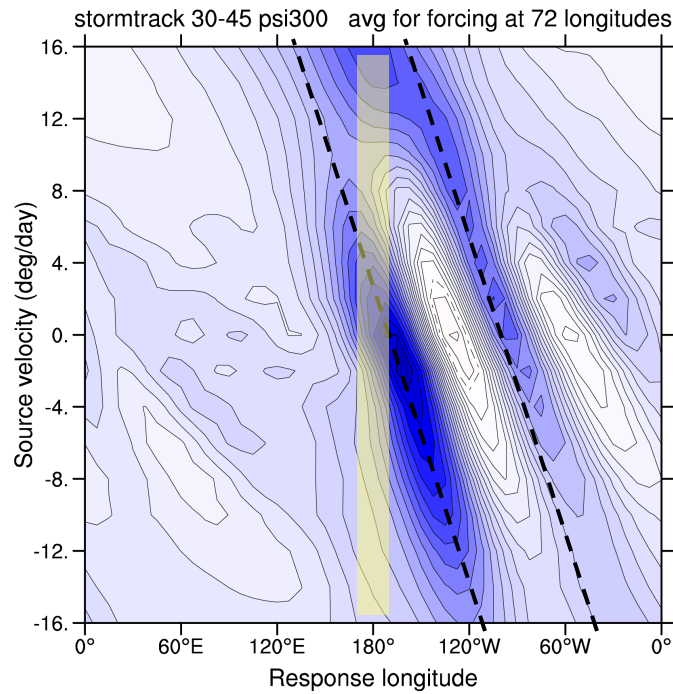


CCM0/FDT

Stormtrack response to eq heat source

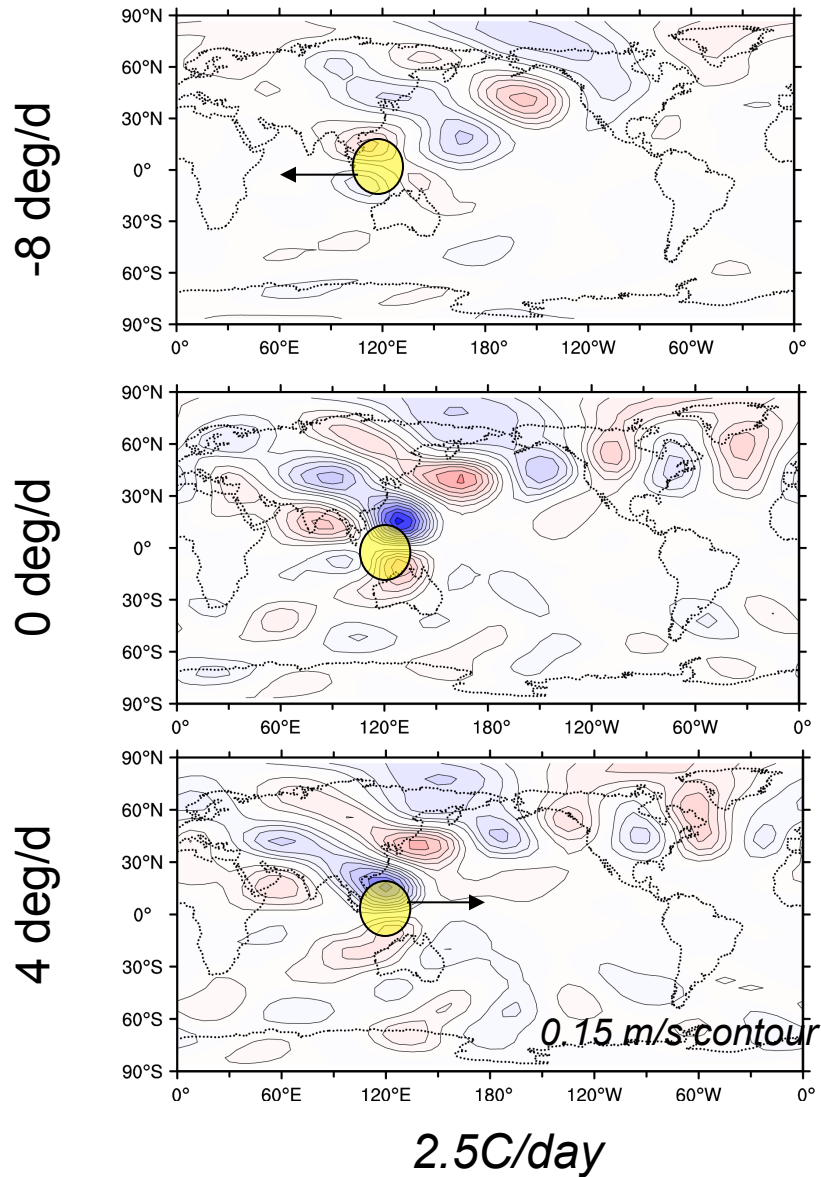
ψ_{300}

$$-\nabla^{-2}(\vec{v}_{\psi}^{bp} \cdot \nabla \zeta^{bp})$$

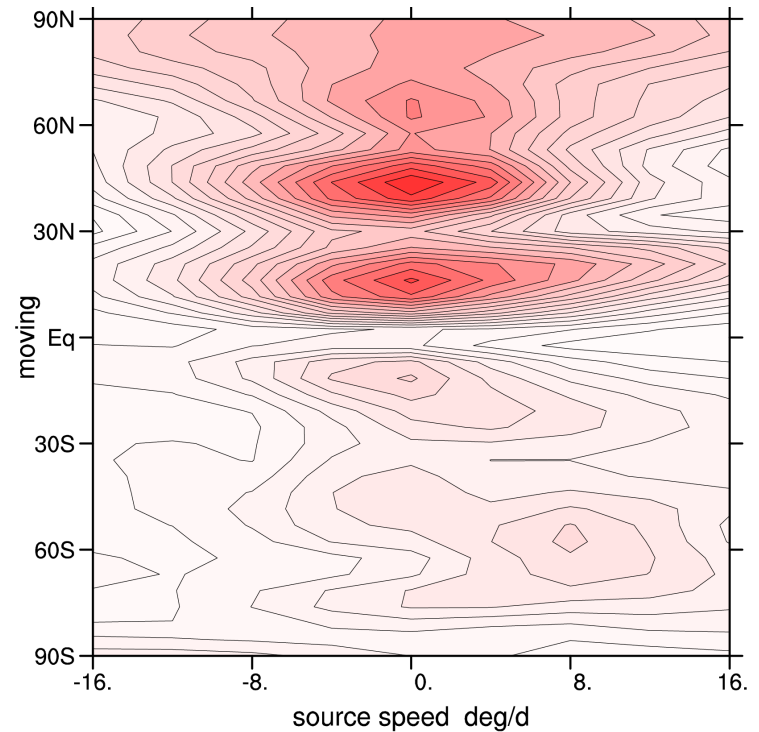


Response to propagating sources (mean v300)

Nature/FDT



Standard deviation of v300
using mean v300



Summary

- Transient Rossby waves influence subseasonal events, including US heat waves
- The structure and amplitude of Rossby waves is affected by the movement of tropical sources
- Midlatitude synoptic eddies are influenced by (slow) transient Rossby waves
- The Fluctuation Dissipation Theorem is a powerful tool for systemic studies of atmospheric response